**Climate Vulnerability and Adaptation Option for Coastal dan Delta Cities: The Makassar Case Study**

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Regional Environmental Management Center for Sulawesi Maluku dan Papua

**Sea Level Rise Projection in INDONESIA**

<table>
<thead>
<tr>
<th>Year</th>
<th>The area Inundated (km²)</th>
<th>Sea Level Rise (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>7,408</td>
<td>0.4</td>
</tr>
<tr>
<td>2050</td>
<td>30,120</td>
<td>0.56</td>
</tr>
<tr>
<td>2100</td>
<td>90,260</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Source: Susandi, et al. 2008

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### Sea Level Rises: Certain Regions of the Country Inundated in the Year of 2100

<table>
<thead>
<tr>
<th>Region</th>
<th>Islands</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Sumatera</td>
<td>Pulau Batu</td>
</tr>
<tr>
<td>West Sumatera</td>
<td>Pulau Sipora, Pulau Bagai Utara, Pulau Bagel Selatan</td>
</tr>
<tr>
<td>Riau Islands</td>
<td>Pulau Singkong, Pulau Selangkap, Pulau Lingga, Pulau Abang Besar, Pulau Pamah, Pulau Berenca, Pulau Tambelan, Pulau Pimpangensibu</td>
</tr>
<tr>
<td>Bangka Belitung</td>
<td>Pulau Belitung</td>
</tr>
<tr>
<td>West Kalimantan</td>
<td>Pulau Kaimana, Kalimantan Selatan, Pulau Laut, Pulau Sebuku</td>
</tr>
<tr>
<td>East Java</td>
<td>Pulau Gililaya, Pulau Giligenteng, Pulau Pulau, Pulau Sepoli, Pulau Raas, Pulau Kangean</td>
</tr>
<tr>
<td>Bali</td>
<td>Pulau Nusa Penida, NTB: Pulau Gili Karam, Sangir, NTB: Pulau Solor, Pulau Pantar, Pulau Adonara</td>
</tr>
<tr>
<td>Sulawesi Selatan</td>
<td>Pulau Selayar, Pulau Tanah Pulau Lampeta, Pulau Bambara, Pulau Kolosoto</td>
</tr>
<tr>
<td>Southeast Sulawesi</td>
<td>Pulau Tukang Besi, Sulawesi Tengah: Pulau Bone</td>
</tr>
<tr>
<td>North Maluku</td>
<td>Pulau Mangole, Pulau Tibusai, Pulau Ohi, Pulau Obilatu, Pulau Damar, Pulau Gebe</td>
</tr>
<tr>
<td>Maluku</td>
<td>Pulau Watabola, Pulau Witer, Pulau Ternata, Pulau Babei, Pulau Kar</td>
</tr>
<tr>
<td>West Papua</td>
<td>Pulau Rumbepon, Pulau Gag</td>
</tr>
</tbody>
</table>

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**Basic Principals for the Environment**

Pasal 28 G ayat 1 UUD 1945: “Every person has the right to pursue happiness, home, and obtain a good and healthy environment and the right to health services”

Pasal 33 ayat 4 UUD 1945: “National economy carried out based on economic democracy using the principals of collectiveness, justice efficiency, sustainable, environmentally friendly, self reliance and preserving progress balance and national economic unity.”
The Government Policy on Coastal Zone: National, Regional and Local


Coastal Protected Area:

Coastal Pollution & Degradation Control:

Coastal Flora-Fauna Preservation & Utilization:

The Local Regulation of Makassar (PERDA) No. 06/2006 Spatial Planning for Makassar

Coastal Flora-Fauna Preservation & Utilization:

The Local Govt. Reg. No. 6 of 2006: Spatial Planning for Makassar (RTRW Kota Makassar)

SLR Impact in Makassar

Sea level rise-SLR is expected to rise by 90 cm in 2100 based on the study: IMPACT EVALUATION OF SEA LEVEL RISE ON INDONESIAN COASTAL CITIES, KOBAYASHI, Hideyuki (2004) in Makassar:

Submerged land 22.9 ha
Impact on population 5,840 household
Impact on buildings 4,168 buildings

KOBAYASHI, Hideyuki (2004)

Sea Level Rise in Indonesia

<table>
<thead>
<tr>
<th>Monitoring Station</th>
<th>Average rise in Mean Sea Level (mm/year)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cilacap</td>
<td>1.30</td>
<td>Hazikuwa, 1993</td>
</tr>
<tr>
<td>Belawan</td>
<td>7.83</td>
<td>ITB, 1990</td>
</tr>
<tr>
<td>Jakarta</td>
<td>4.38</td>
<td>ITB, 1990</td>
</tr>
<tr>
<td>Semarang</td>
<td>9.37</td>
<td>Berdasarkan data dari 1984-2006</td>
</tr>
<tr>
<td>Surabaya</td>
<td>5.00</td>
<td>Berdasarkan data dari 1984-2006</td>
</tr>
<tr>
<td>Surabaya</td>
<td>1.00</td>
<td>Berdasarkan data dari 1984-2006</td>
</tr>
<tr>
<td>Semarang</td>
<td>3.47</td>
<td>ITB, 1990</td>
</tr>
<tr>
<td>Pinjang, Lampung</td>
<td>4.15</td>
<td>P3O-LPI, 1991</td>
</tr>
</tbody>
</table>

Sumber: MoE, 2007
Sea Level Rise in Indonesia

Source: Sutisna S., et al., 2002
Variation and trend for MSL (Cm) from three permanent monitoring station 1984 s/d 2002. Average rise : 8 mm/year

A Study Area of Climate Vulnerability and Adaptation Assessment Option for Makassar
Vision of Makassar: A World-Class Waterfont City

The Center Point of Indonesia: A Megaproject built along the Coastal Areas of Makassar

Reklamation Area

Losari Beach

GMTDC Mall

Celebes Convention Centre (3C)

Revitalization of Losari Beach, Makassar

Climate VaA Assessment: SLR Impact on Makassar and Its Vicinity [MAMMINASATA]

- **Parties Involved**: Experts from Hasanuddin University in collaboration with the MoE Regional Office for Sulawesi Maluku and Papua based in Makassar

- **The Study Area**: The Maminasata area → the regencies of Maros, the city of Makassar, Sungguminasa (Gowa) and Takalar regencies

- **The Objectives**:  
  - Delineation of land area inundated by SLR in 2050 and 2100.  
  - Assessment of land use and land cover on the inundated area;  
  - Economic valuation on the inundated area  
  - Formulation of adaptation options
Results of the Study

Inundated sea water for year 2050 and 2100 within the Mamminasata area

Estimated inundated area within Mamminasata by year 2000 & 2100

<table>
<thead>
<tr>
<th>No.</th>
<th>Regency</th>
<th>Inundated Area (ha)</th>
<th>SLR of 56 cm</th>
<th>SLR of 110 cm</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Maros</td>
<td>1.143</td>
<td>905</td>
<td>30</td>
<td>2.076</td>
</tr>
<tr>
<td>2</td>
<td>Makassar</td>
<td>905</td>
<td>2.010</td>
<td>2.919</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Gowa</td>
<td>32</td>
<td>2.025</td>
<td>233</td>
<td>2.598</td>
</tr>
<tr>
<td>4</td>
<td>Takalar</td>
<td>1.131</td>
<td>1.487</td>
<td>2.596</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3.214</td>
<td>4.612</td>
<td>7.825</td>
<td></td>
</tr>
</tbody>
</table>

Source: Amran Achmad & PPLH Regional Sumpapua, 2009

SLR Impact on Tallo River & its Vicinity, Makassar in the Year of 2050 & 2100

Source: Amran Achmad & PPLH Regional Sumpapua KLH, 2009

SLR Impact on the Fishermen Village, Makassar in the Year of 2050 & 2100

Source: Amran Achmad & PPLH Regional Sumpapua KLH, 2009
SLR Impact on the Area along the Makassar Highway & Its Vicinity in the Year of 2050 & 2100

SLR of 56 cm (2050)

SLR of 110 cm (2100)

Makassar Strait

Source: Amran Achmad & PPLH Regional Sumpapua KLH, 2009

SLR Impact on Poatere Port & Its Vicinity, Makassar in the Year of 2050 & 2100

SLR of 56 cm (2050)

SLR of 110 cm (2100)

Poatere Port

PT Eastern Flour Mill

Pertamina

Makassar Strait

Source: Amran Achmad & PPLH Regional Sumpapua KLH, 2009

SLR Impact on Makassar Port & Its Vicinity, Makassar in the Year of 2050 & 2100

Makassar Strait

Massar Port

PTM Pantai Gapura Hotel

Makassar Golden Hotel

Makassar Strait

Source: Amran Achmad & PPLH Regional Sumpapua KLH, 2009

SLR Impact on Losari Beach, Makassar in the Year of 2050 & 2100

Losari Beach

Makassar Golden Hotel

Imperial Arya Duta Hotel

Makassar Strait

Source: Amran Achmad & PPLH Regional Sumpapua KLH, 2009
Adaptation to Sea Level Rise

- **Relocate**: option chosen if economic and environmental impact are huge, i.e. large floods Makassar with its business centers and infrastructures along the coast would be difficult to relocate.

- **Accommodate**: carried out through reclamation, raising buildings or shifting to aquaculture. Bugis villagers have been developing traditional houses (platform house above land), suitable for adaptation to SLR. Housing developers should be inspired by their traditional technology.

- **Protect**: hard structure such as breakwater or seawalls and soft structure such as in re-vegetation of mangrove or beach nourishment. Practice cautiously when "working with nature".

Adaptation to Sea Level Rise

- **Planning**: The regional planning process sponsored by the Dept. of Interior (Musrenbang process). Revised spatial plan, designing new coastal protective areas.

- **Public Awareness**: Raising awareness on sea level rise and its potential impact, community capacity in dry land agriculture management techniques, community capacity in aquaculture management.
Adaptation to Sea Level Rise

**Community efforts:**
Community efforts to avoid inundation during high tides during the western monsoon period.

**Local government efforts:**
The local government of Makassar has embarked on adaptation in anticipating sea level rise through rehabilitation and development of sea wall in the Losari Beach area. This has been carried out also by the Takalar Regency by building seawall along the road to Puntondo, nevertheless it is not constructed to protect against a rise of 110 cm in sea level by 2010.

Lessons Learned and Remaining Challenges [1]

- Modelling for local specific areas using the downscaling method should be developed to precisely delineate the local area instead of using national predictions.
- A more comprehensive total economic valuation should be carried out based on the more accurate delineation.
- Integrating the new findings to the existing spatial plan should be carried by local government to minimize the risk and cost.
- Develop appropriate adaptation measures involving policy development and local action and introducing co-benefit innovative approaches for adaptation measures.

Lessons Learned and Remaining Challenges [2]

- Shifting the mindset of local stakeholders including policy makers and local communities to digest the issue and translate it to their action.
- By using a moderate prediction we realize the extent of the damage which can occur in the Mamminasata area, let alone the new and extreme prediction findings which are now being reported as regards climate change;
- Other coastal cities should be concerned on their spatial plan based on this simple vulnerability and adaptation assessment. Cities are encouraged to carry out their their own vulnerability and adaptation assessments and integrate the result into their city spatial plan.

Lessons Learned and Remaining Challenges [3]

- Cities and communities in low-lying coastal and delta regions will have to be creative
- Local tradition must also be incorporated in anticipating climate change.
- At the national level, planning is carried out through a series of consultation stages at the local, regional and national level through the Musrenbang process carried out annually between local governments and the Ministry of Interior.
- To fit the environment agenda in, it is important for environmental officers within the region to consult with the environmental regional office in identifying priorities on environmental issues prior to the Musrenbang process held annually in April.
Thank You